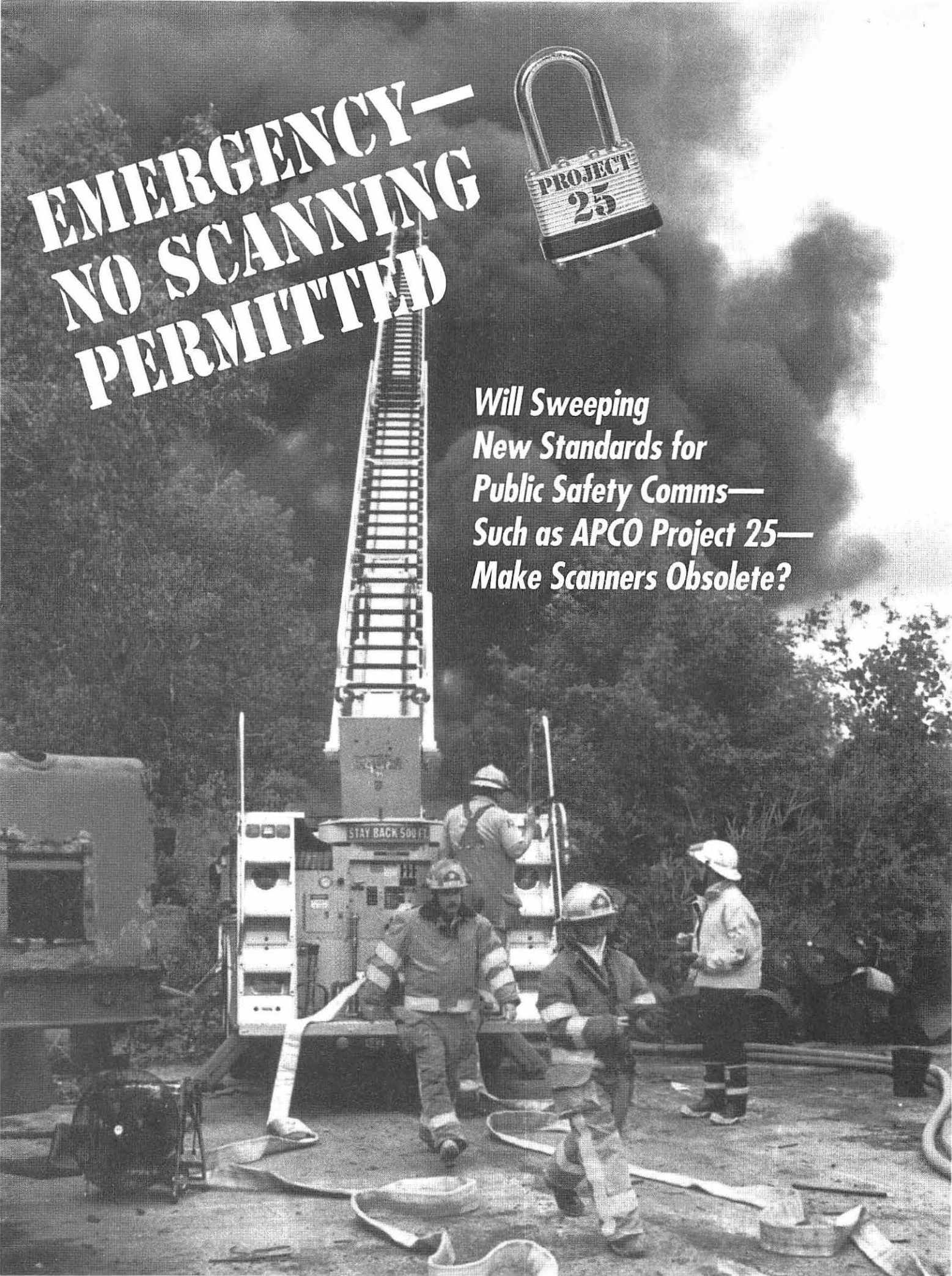

EMERGENCY—
NO SCANNING
PERMITTED
PROJECT
25
Will Sweeping
New Standards for
Public Safety Comms—
Such as APCO Project 25—
Make Scanners Obsolete?
STAY BACK 500 FT

Project 25 is set to take public-safety VHF/UHF communications into the next century with narrowband digital modulation and unprecedented interoperability. Will these standards mean the end of scanning as we know it?

By Kirk Kleinschmidt, NT0Z

Every 20 years or so, advances in radio and telecommunications technologies sweep across the landscape, changing the way public-safety agencies communicate. These changes increase the scope and type of possible comms—and they turn the monitoring hobby on its ear in the process!

If "listening in" technology trickles down to hobbyists, technology improvements are good for "business." After all, to stay in the game, you need up-to-date radios and accessories. Equipment sales go up, companies remain healthy, newcomers join the ranks, etc (I'll see your computer interface and raise you a CTCSS decoder?). However, if technology leapfrogs hobbyists, the future is uncertain. As of 1995, the future of hobby scanning is uncertain....

The culprit lurking just around the technology corner this time is digital radio, the very mention of which has been known to strike fear into the hearts of die-hard monitors!

Digital radio has been sneaking up on us for at least a decade, always in the back of our minds. Several manufacturers produce 800-MHz trunked systems with proprietary data encryption, second-generation digital cellular telephone service is up and running in many larger cities, and even rural law-enforcement agencies have encrypted data terminals in their squad cars.

Progress to date on the digital front, however, has been incremental, and there's still lots of stuff "in the clear," even if some of the juicier catches have become *braaaaaps* and *bluuuurps* to our analog FM ears.

With APCO 25, the switch to digital radio systems is almost set in stone. It's not a question of whether the switch will take place, it's mostly a question of when things will start and how fast they will happen.

Accelerating the process is a set of standards that every manufacturer (or most manufacturers) will adopt, eliminating the hit or miss approach of producing proprietary, incompatible systems.

Simply stated, APCO 25, the "mother of all public-service radio standards," stands a very good chance of revolutionizing VHF/UHF public-safety communications (plus amateur radio) in this country, and perhaps worldwide.

APCO 25, known by most contributors as simply Project 25, is a hot topic among government and industry players, and

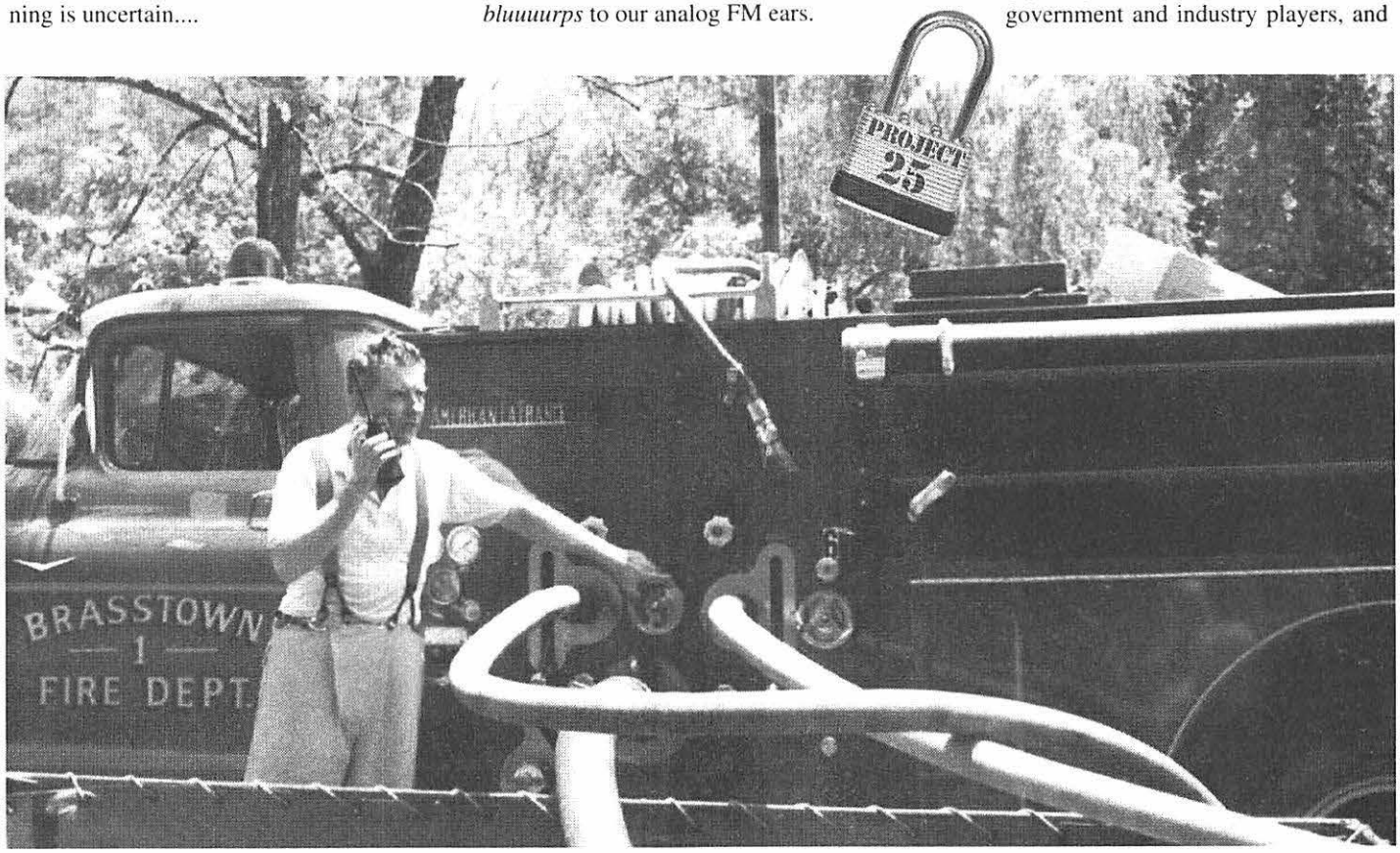


Photo by Rachel Baughn

five interim government standards have already been published for consideration, review and comment in the Federal Register. As this article went to press, the International Telecommunication Union in Geneva expressed interest and support for Project 25.

This article takes a look at Project 25 and what it may mean for public-safety agencies and uncounted thousands of scanner hobbyists.

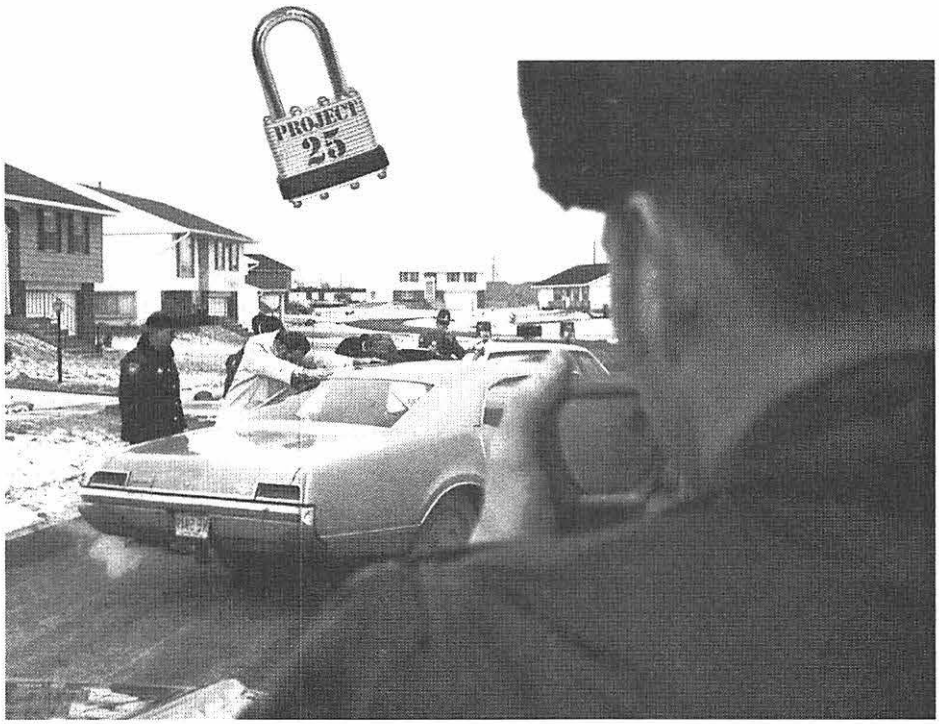


Photo courtesy of Motorola

Project 25

Describing a complex project simply, Project 25 is a joint federal/state/local effort to set common technical standards (a suite of standards) for VHF/UHF radio systems, handheld and base, among all public-safety communicators (including federal agencies and the military).

Project 25-conforming radios will use up-to-date digital modulation to reduce bandwidth, increase communications range and provide for several levels of digital security and layered interoperability among service providers (while providing backward compatibility with analog FM systems).

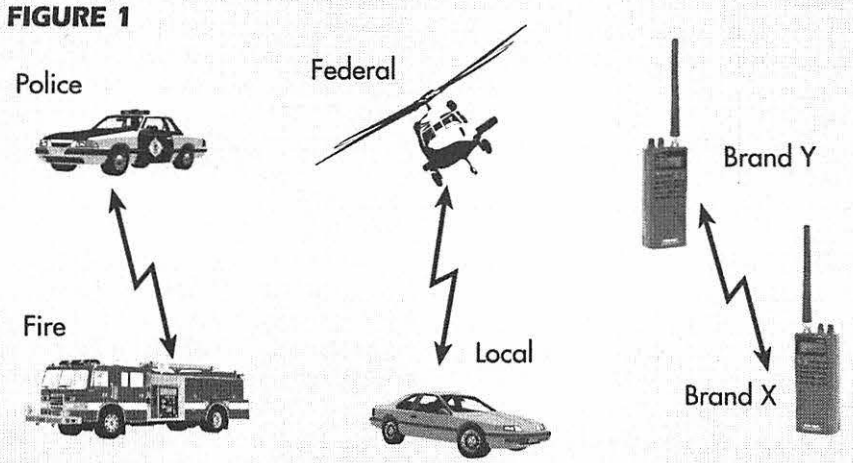
Imagine if police, fire, amateur radio, county, state and federal communicators could talk to one another without the hassle of today's largely incompatible radio systems. That's Project 25's goal.

As the standard is implemented, public-safety comm bandwidths will shrink from today's 25 kHz (analog FM), to 12.5 kHz (first-generation Project 25 digital voice systems), to an eventual 6.25 kHz (second-generation Project 25 digital)—a 4:1 gain in spectrum efficiency.

Manufacturers will gain in "efficiency" as well. Today's VHF/UHF communicators must choose from a hodgepodge of products and comm systems provided by many discrete manufacturers. Radios from one manufacturer aren't compatible with those of another. If you're a government agency or a municipal police department, you buy Ericsson gear, and stay with Ericsson gear. Buy Motorola, stay with Motorola. Buy E.F. Johnson, stay with E.F. Johnson. And if your present system doesn't suit your agency's needs, you're locked in because of incompatibility.

Project 25, in setting common standards, will allow every manufacturer to produce compatible radios, increasing competition and bringing down prices. According to Steve Nichols, general manager of BK Radio (Bendix King), an emerging Project 25 manufacturer, "When similar standards were set for America's cellular telephone industry, competition and product availability exploded and prices fell dramatically. A similar scenario is envisioned for public-safety communicators."

FIGURE 1



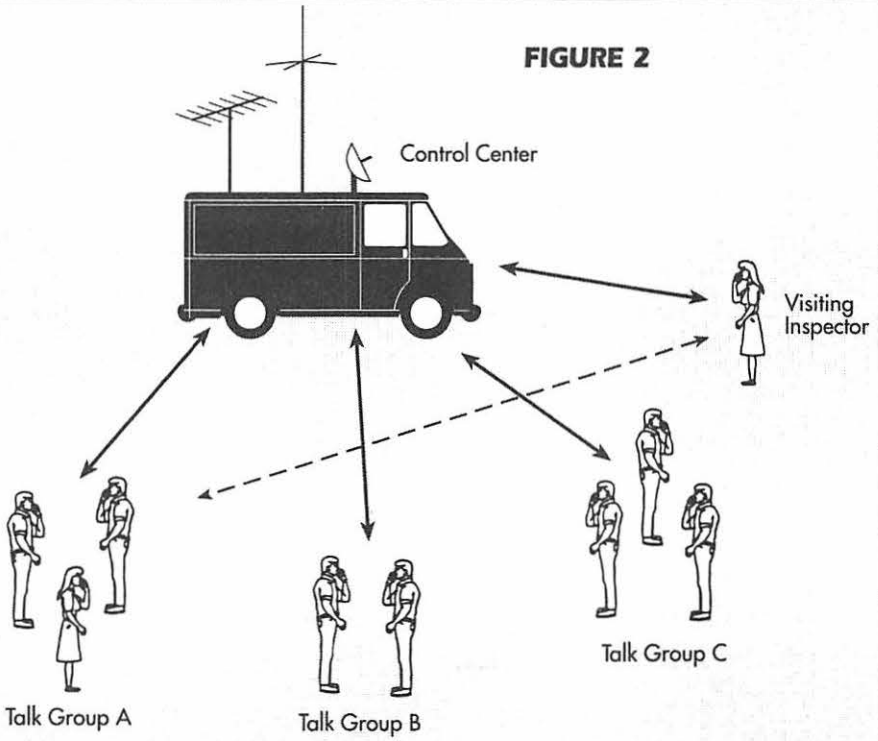
Project 25's main user benefits are interoperability and competitive pricing and manufacturing.

APCO History

APCO, the Association of Public-Safety Communications Officials, International—a major proponent of Project 25—was founded in the 1930s as the Association of Police Communications Officers. The group's early work included the popular 10-codes used for decades by law enforcement agencies to streamline radio comms. Recently, APCO's Project 16, "800-MHz Public Safety Trunking Recommendation," helped usher in the present era of more flexible, trunked public safety radio systems. APCO is designated by the FCC as the frequency coordinator for the Police Radio Service.

Project 25, the first standard-setting effort encompassing so many levels of government and public safety users, got underway in 1989. What's also interesting is that Project 25 is user-driven, not manufacturer driven. Under the old system, manufacturers developed technology and sold it to users. Project 25, tapping its many contributors and a wide experience base, evaluated existing technology, incorporated emerging technologies and set standards to be matched by multiple manufactur-

FIGURE 2



Because each Project 25 radio has its own digital address (like an ID number), "talk group" operation is built in. Here's one way it works: Let's say that there are several accident investigators in each talk group (team) depicted above as A, B, and C, plus one visiting federal inspector. Normally, when a member of talk group A keys his radio, only those investigators in group A will hear his transmission (even though there may be other traffic being passed on the same FDMA "channels"). To talk to the control center, the investigator in talk group A need only switch to the control center's "channel" on his hand-held. If he wanted to talk to the visiting federal inspector—and no one else—he could key in the inspector's "address" (or switch to the inspector's "channel")—communicating directly or via the control center's repeater. For emergencies, the investigator could switch to the "emergency channel," which would allow his transmission to be heard on everyone's hand-held. Remember: with FDMA systems, everyone uses the same "frequency pool"—it's the addresses and specific "channel" allocations that are dynamically allocated.

ers. APCO joined in standard-setting efforts with the National Association of State Telecommunications Directors and the Federal Telecommunication Standards Committee.

General Project 25 Radio Features

Compared to even the most sophisticated analog FM systems used today, radios conforming to Project 25 standards still seem somewhat futuristic. Project 25-compatible radios must:

- provide voice quality equal or greater to that of conventional analog FM systems.
- provide data-transmission capability (and data interfaces) with quality equal or greater than that of conventional analog FM systems.
- provide greater spectral efficiency compared to current systems. Trunked systems, presently used by thousands of public-safety and commercial users, use a control channel (a data link) to assign frequencies dynamically, on demand, for digitized data and voice transmissions. This allows for greater frequency re-use and spectrum efficiency.
- accommodate standard data-encryption methods.
- offer range/power and signal-to-noise performance equal or greater than those of existing FM systems.
- be suitable for repeater or mobile-relay operation.
- conform to APCO Project 16 trunking requirements.
- be standardized to ensure wide interoperability, conventional and trunked, with a common encryption algorithm and over-the-air-rekeying (OTAR).
- be producecable by many manufacturers to ensure competitive purchasing.
- be designed with open system architecture to accommodate future system enhancements (including the shift to a 6.25-kHz signal bandwidth).
- be backward compatible with conventional analog FM radios; dual-mode equipment being desirable.
- be physically similar in size to existing hand-held and base-station FM radios.
- be priced competitively.

The list of features is impressive, and if Project 25 gear can be built and sold at present-day prices (about $800-$2800 for a full-featured public-safety hand-held), it will likely be an even hotter prospect for wide acceptance by served agencies.

System and User Features

The full Project 25 system encompasses at least six system interfaces, including remote data gateways, access to the telephone network, network management, and multilayered voice and data encryption systems. Some of the features and systems are still being ironed out. This introductory article will highlight only a few of Project 25's systems and features.

Project 25 radios will use a digital modulation system similar to that being tested in second-generation cellular phone systems in the US and other countries around the world. The frequency-division-multiple-access (FDMA) modulation system transmits and receives voice data that has been digitized by the radio's VOCODER (voice digitizer, or voice coder). On the receiving end, the digital information is converted back to analog speech.

Because the FDMA system is digital, voice can be transmitted simultaneously with underlying data (for example, every time an officer keys his or her radio, data from a "wearable" GPS satellite navigation receiver could ride along, giving the officer's dispatch center a real-time update of the officer's position) and various software or digital-signal-processing (DSP) manipulations, including multilayered data-encryption, can be performed in real-time, with no loss of audio quality. (Project 25's aggregate data rate is 9600 bits.)

Some government Project 25 radios would incorporate "almost impossible to break" data-protection algorithms, while public-safety Project 25 radios would implement less-stringent encryption methods (or no encryption at all, which would pave the way for Project 25-compatible scanners!). The radios would be fully interoperable, except for the data encryption software or firmware (government radios would be interoperable with public-

Photo by Bob Grove

safety radios when each was using the less-stringent data protection scheme).

Al Crawley, Department of Defense Division Chief for RF Communications, says military radio users are looking forward to standardized gear: "For once we won't have to use 10,000 specially-made radios! And all that achieved through standards that will dramatically reduce costs, increase security, and allow many manufacturers to compete."

Another interesting feature of Project 25 radios is "talk group" operation. Each radio would have its own digital "address," which allows users to take full advantage of the FDMA transmission system. Two or more addresses could be assigned to a talk group, and although hundreds of users might be using an agency's frequencies, only radios assigned to the group would receive calls addressed to a particular group.

Want to talk to only one other user among hundreds? Key in your recipient's address and only his or her radio will hear your call. Unique addressing, changeable on the fly through computer or user control, makes Project 25 radios much more flexible than present systems.

Because of Project 25's digital packet data structure, users don't have to "hear" the data burst at the beginning of a transmission to join a talk group. Unlike many existing error-correction techniques, the Project 25 protocol provides for "late entry."

Manufacturers and Time Frames

Although some Project 25 details and systems need to be worked out and finalized, several manufacturers are already producing working "Project 25-like" hand-helds using off-the-shelf components.

Motorola, which holds many of the patents required for Project 25-compatible radio systems, has been producing proprietary "big bucks" versions of similar radios for several years, selling them mostly to the government. It stands to gain handsomely in equipment sales and licensing royalties.

"We're currently working on our first Project 25 radios," said BK Radio General Manager Steve Nichols. "We are licensing technology as necessary from Motorola and other manufacturers." Several other manufacturers have followed suit, and three or four have actually demonstrated prototype radios.

Shepherding standards through the government-approval process can be a tricky prospect, but most experts agree that Project 25 could be implemented by as early as 1996 to 1998.

At press time, the government comment period had just closed on the five proposed

Photo courtesy of the Philadelphia Fire Department

TETRA: European Digital Radio Standards

Spearheaded by the European Telecommunications Standards Institute, TETRA (the Trans European Trunked RAdio system) is Europe's Project 25 counterpart. Its objectives are similar, although its design is optimized for a more densely populated environment.

Here is a partial list of TETRA's design goals:

- to offer increased spectrum efficiency in land mobile networks.
- to offer increased voice quality and provide for data encryption.
- to provide users with wide ranging, flexible services for voice and data communications, and access to public fixed networks (PSTN, PDN, ISDN, etc).
- to use state-of-the-art equipment to provide savings in weight, power consumption and cost.

TETRA and Project 25 share many common denominators. These, and several major differences, are contrasted in the following partial Project 25/TETRA feature comparison.

TABLE 1
TETRA/Project 25 Partial Feature Comparison

Feature	TETRA	Project 25
Frequency bands	380-933 MHz (approx)	150-950 MHz (approx)
RF carrier spacing	25 kHz (4-slot TDMA)	12.5 and 6.25 kHz
Max base station ERP	25 W	350 W
Mobile station ERP		
Mobile	10 W peak	10-110 W peak
hand-held	1 W peak	1-5 W peak
Cell radius		
suburban	3.8 km	7.6 km
rural	17.5 km	35 km
Modulation method	TDMA	FDMA

Project 25 interim standards, and the standards had just been formally introduced to the international community in Geneva. Whether the international angle will have an effect on possible domestic implementation has yet to be determined.

Project 25-Compatible Scanners?

To date, scanner manufacturers have not been directly involved in Project 25, and most are simply keeping a low-key "corporate eye" on the situation. The biggest variables for scanner producers seem to be the precise timetable for adoption of Project 25, and the question of data encryption—how prevalent will data encryption be among Project 25 users?

Sergeant John Powell, WB6SDS, past APCO president and a member of the Project 25 Steering Committee, thinks Project 25 will have a big impact on scanner users, one way or another:

"If data encryption is expensive for public-safety agencies to implement, there will be many local users that will transmit 'in the clear,' that is, they'll use only Project 25 digital protocols without an extra layer of encryption. If that happens, there could be a big market for Project 25-compatible scanners."

If encryption software becomes inexpensive, many more agencies could take advantage of it, making a Project 25 scanner relatively ineffective. Don Speights, a senior staffer at NTIA, says that even if data encryption isn't all that expensive, many agencies may choose not to encrypt routine communications because of the administrative overhead involved.

Photo courtesy of Motorola

"Encryption schemes and codes have to be managed," says Speights, "even when radio systems such as Project 25 make encryption easy. Even if the cost of purchasing and managing encryption is only $50 per radio per year, that adds up quickly, especially if your agency has a thousand radios."

Powell says many agencies may choose to encrypt only the most sensitive comms, much like many larger agencies do now using existing proprietary digital radio systems. That would leave the bulk of the digital comms available to owners of Project 25 scanners.

In addition to the encryption aspect, whether manufacturers eventually produce Project 25 scanners depends on how much it costs to license the "intellectual property rights" necessary to legally produce Project 25 hardware. These fees have not been determined, and expectations range from reasonable to prohibitive.

"Scanner manufacturers will have to license the technology," says Powell, "which could be expensive." Speights agrees, and urges potential manufacturers to join the project as early as possible, noting that the major players are already onboard.

Robert Miller, AA5FL, Radio Shack's VP of merchandising procurement and development, says that although his company is aware of Project 25 and is "keeping tabs on it," he says the scanner marketing giant "will do whatever it takes to produce an aboveboard, legal Project 25 scanner"—if the marketplace demands one.

Miller also sees potential political issues looming: "The sweeping nature of Project 25

may force the public to pressure the government to back down on the encryption issue. After all, the public may demand access to routine public-safety comms if for no other reason than to hear how its tax dollars are being spent."

So how long might we have before digital scanning becomes an issue in our in-home listening posts?

Powell, a sergeant with the University of California, Berkeley, police department, expects agency budgeting to affect the phase-in process: "Realistically, I think Project 25 will be phased in over the next five to ten years. There are a few bumps in the road, but increased congressional pressure for interoperability and cost savings will likely ensure the project's survival."

Photo courtesy of GE

Thanks

In addition to those quoted in this article, I'd like to thank the helpful folks at APCO (2040 S Ridgewood Ave, South Daytona, FL; tel 904-322-2500) for faxing me reams of documents.

Special thanks go to Bob Fenichel, WA2TMT, and John Powell, WB6SDS, for reviewing this article for accuracy and for spending their valuable time on the telephone helping me through basic and esoteric "Project 25-speak."

Ham Radio and Project 25

Project 25 standards, if applied to Amateur Radio, could really add "spice" and welcome spectrum efficiency to today's popular VHF/UHF bands. And it's a given that almost every feature enjoyed by public-safety users could be enjoyed by ham operators (data encryption is unlikely, though!).

Robert Fenichel, WA2TMT, a member of the Project 25 steering committee and chairman of the Federal Telecommunication Standards Committee, Land Mobile Radio Subcommittee, sees Project 25 migrating to Amateur Radio sooner or later:

"Project 25's digital nature [talk-group operation versus analog tone squelch, for example] makes it ideal for future Amateur Radio applications. There are issues, however, namely cost, initially, and certain technology questions. Project 25 also requires powerful DSP processors."

BK Radio General Manager Steve Nichols sees the migration happening from the top down. "Hams tend to be early adopters of new technology, and many hams are employed by government agencies and commercial concerns that will be using the new Project 25 technology as soon as it hits the streets. When they get their hands on it at work, they'll probably want to use it in their ham radio pursuits."

DoD Chief Al Crawley sees the adoption of Project 25, or something like it, as inevitable. "Digitized voice and data will happen in amateur radio. It's only a matter of time. These digital systems offer improved voice quality, increased error-handling capability (which can increase communications range) and far greater spectrum efficiency."

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